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Stochastic similarities between the microscale of vertical thermal jet and macroscale hydrometeorological processes

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Most hydrometeorological processes (such as temperature, wind etc.) are governed by turbulent state. In this study, we seek for stochastic similarities between the correlation structure of hydrometeorological processes (as has been already derived from global analyses of surface stations) and experimental vertical thermal jet at different states. It is well established experimentally that a jet flow close to the nozzle (at the zone of the core) is laminar and far from the nozzle (at the zone of established flow) fully turbulent. We apply several stochastic tools (autocorrelation, power spectrum, climacogram etc.) at the two aforementioned zones as well as at the intermediate zone of flow establishment (5 to 15 diameters away from the nozzle) in an attempt to identify any stochastic similarities and differences between the three zones, and thus, between the laminar and turbulent flow state transition. For this, spatio-temporal temperature records are obtained on the plane of symmetry of heated vertical round jets (for a laboratory turbulent scale at the order of mm) using tracer concentration measurements via a planar laser induced fluorescence technique (PLIF). Finally, a characterization of jet thermal turbulent state is proposed based on the Hurst parameter that is used for the identification of the long-term persistent behaviour (or else called Hurst-Kolmogorov behaviour) of a process.
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